

### **REMARKS**

The final Office Action of October 23, 2008 has been reviewed and the Examiner's comments carefully considered. Claims 1 and 3 have been amended and claims 2, 5 and 6 have been cancelled by way of this Amendment. Accordingly, claims 1, 3, 4 and 7 are currently pending in this application with claims 1 and 3 being in independent form. Support for the amendments can be found in Fig. 1, at page 4, lines 12-26, at page 8, lines 14-25 of the specification, and in original claim 2. Applicants respectfully submit that no new matter has been added by way of this Amendment.

#### **Rejections Under 35 U.S.C. §103(a):**

Claims 1, 3 and 5 stand rejected under 35 U.S.C. §103(a) for obviousness over U.S. Patent Application Publication No. 2002/0022292 to Barber et. al. (hereinafter "Barber") in view of U.S. Patent Application Publication No. 2004/0016718 to Hwu et al. (hereinafter "Hwu"). Claims 2 and 6 stand rejected under 35 U.S.C. §103(a) for obviousness over Barber in view Hwu, and in further view of U.S. Patent No. 5,646,657 to Aoki (hereinafter "Aoki"). Claim 4 stands rejected under 35 U.S.C. §103(a) for obviousness over Barber in view of Hwu, and in further view of U.S. Patent No. 4,487,828 to Hladovcak et al. (hereinafter "Hladovcak"). Claim 7 stands rejected under 35 U.S.C. §103(a) for obviousness over Barber in view of Hwu, and in further view of U.S. Patent No. 6,530,652 to Kim et al. (hereinafter "Kim"). In view of the foregoing amendments and following remarks, reconsideration and withdrawal of these rejections are respectfully requested.

The present invention, as defined by amended claim 1, is directed to a method of manufacturing a piezoelectric element, including the steps of: applying a masking agent to a surface of a piezoelectric material to form a film of the masking agent on the surface of the piezoelectric material; patterning the film of the masking agent into a predetermined masking pattern; selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film; holding the patterned film in contact with a vapor of a solvent for the masking agent, diluted with an inert gas, so as to fluidize the film to a domed shape on the surface of the piezoelectric material, wherein the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas; curing the dome-shaped film; and dry etching the piezoelectric material together with the cured film, so as to process the piezoelectric material into a three-dimensional convex profile corresponding to thickness distribution of the domed shape.

The present invention, as defined by amended claim 3, is directed to a method of manufacturing a piezoelectric element, including the steps of: applying a masking agent to a surface of a substrate made of a piezoelectric material to form a film of the masking agent on the surface of the substrate; patterning the film of the masking agent into a predetermined masking pattern; selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film; contacting the patterned film with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape, wherein the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas; curing the dome-shaped film; and dry etching the surface of the substrate together with the cured film to process the substrate into a three-dimensional convex structure of a profile corresponding to a thickness distribution of the domed shape.

Applicants submit that the teachings of Barber, Hwu, Aoki, Hladovcak and Kim, taken separately or combined, fail to teach or suggest all of the claimed limitations of amended claims 1 and 3.

With regard to Barber, this reference teaches a method for shaping thin film resonators (20) comprising a piezoelectric substrate (21). A photo resist (22) is first applied to a surface of the substrate (21) and then shaped into a pattern of resist cylinders (23) on the substrate (23). The photo resist cylinders (23) are then melted into dome shaped drops (24) by one of several possible techniques, including by exposing the resist cylinders (23) to the vapors of a suitable resist solvent in an evacuated heated chamber. Reactive Ion Etching (RIE) or another suitable technique is then used to transfer the resist lenses into the substrate (21) to form a partial resist (25). Upon completion of the RIE process the final structure (26) of the resonator (20) includes the desired contour. Please note Fig. 3 and paragraphs [0028]-[0030] appearing on page 3 of Barber.

According to the Examiner, Barber inherently teaches that the solvent vapor is diluted with an inert gas because the photo resist cylinders (23) are exposed to the vapors of the solvent in the presence of air. Applicants respectfully disagree. Barber expressly teaches at paragraph [0030] that the photo resist cylinders (23) are exposed to the vapors of the solvent in an evacuated heated chamber. Thus, Barber teaches that the vapors of the solvent are not diluted by any gas. At no point does Barber teach or suggest contacting a patterned film of masking agent with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape or that the vapor diluted with the inert

gas is formed by bubbling the solvent with the inert gas, as is claimed. Further, as acknowledged by the Examiner, Barber also fails to teach or suggest selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film of the masking agent.

With regard to Hwu, this reference teaches a process for making micro-optic elements having a plurality of photo resist elements (105) formed on a substrate (101), which are then melted by heat (115) to form domed photo resist elements (117), which are subsequently etched by an etch gas (125) for form a number of lenses (127). Please note Figs. 1 and 2 and paragraphs [0020]-[0029] appearing on pages 2-3 of Hwu. Hwu does not teach or suggest contacting a patterned film of masking agent with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape, that the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas, or selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film of the masking agent, as is claimed. Thus, Hwu does not fairly suggest a modification to the process taught by Barber that reaches the claimed invention.

With regard to Aoki, this reference teaches the application of a water and oil repellent film (21) on the surface of a nozzle sheet (10) made of polyimide to form a nozzle plate (9) for an ink jet printer head for the prevention of variations of the ejected ink. Nozzles (11) are formed in the sheet (10) and layer of repellent film (21) by an excimer laser. To that end, the repellent film (21) also includes an ultraviolet absorbing agent to increase dimensional accuracy in the processing of the repellent film (21) by the excimer laser. Please note Figs. 2 and 3 and column 3, line 30 to column 4, line 34 of Aoki.

Applicants respectfully submit that “[t]he Examiner must determine what is ‘analogous prior art’ for the purpose of analyzing the obviousness of the subject matter at issue.” A prior art reference must either be in the Applicant’s field of endeavor or be reasonably pertinent to “a need or problem known in the field of endeavor at the time of the invention and addressed by the patent [or application at issue].” MPEP §2141.01(a)(I).

Applicants submit that Aoki is non-analogous prior art and cannot be relied upon as a basis for rejecting Applicants’ claims. The claimed invention relates to the manufacture of piezoelectric elements having three-dimensional convex profiles formed thereon. An oil-repelling film is applied to a surface of the substrate to repel solvents of the

masking agent from the surface of the substrate so as to reduce a surface tension of the substrate at the surface part where formation of piezoelectric elements is not intended. Please note Fig. 1(b) and page 5, lines 17-27 of the Specification. Aoki does not relate to the manufacture of piezoelectric devices or to repelling etchants from a substrate surface during an etching process. Further, the oil repellent film taught by Aoki is provided on a nozzle sheet for an ink jet printer head to improve the ejection characteristics of the nozzle. The present invention does not address the prevention of variations of ejected ink from nozzle plates in an ink jet printer head.

Moreover, Aoki does not teach or suggest contacting a patterned film of masking agent with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape, that the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas, or selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film of the masking agent, as is claimed. Rather, Aoki teaches applying the oil repellent (21) across the entire surface of the nozzle plate (9). Thus, Aoki does not fairly suggest a modification to the process taught by Barber that reaches the claimed invention.

With regard to Hladovcak, this reference teaches curing laminates of dry film of photo-sensitive polymer material applied to surfaces (13,14) of a substrate (11) of a printed wiring board (10) with ultra-violet light. Please note Figs. 1 and 3 and column 3, line 8 to column 4, line 12 of Hladovcak. Hladovcak does not teach or suggest contacting a patterned film of masking agent with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape, that the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas, or selectively applying an oil repellent to surface portions of the substrate which are not covered with the patterned film of the masking agent, as is claimed. Thus, Hladovcak does not fairly suggest a modification to the process taught by Barber that reaches the claimed invention.

With regard to Kim, this reference teaches the dry etching of a piezoelectric element with chlorine gas. Please note column 7, line 17-22. Kim does not teach or suggest contacting a patterned film of masking agent with a vapor of a solvent for the masking agent, diluted with an inert gas, to fluidize the patterned film into a dome shape, that the vapor diluted with the inert gas is formed by bubbling the solvent with the inert gas, or selectively applying an oil repellent to surface portions of the substrate which are not covered with the

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patterned film of the masking agent, as is claimed. Thus, Kim does not fairly suggest a modification to the process taught by Barber that reaches the claimed invention.


Applicants submit that independent claims 1 and 3 are allowable for at least the foregoing reasons, as the teachings of the prior art of record, including Hwu, Aoki, Hladovcak and Kim, are not sufficient to overcome the deficiencies in the teachings of Barber with respect to claims 1 and 3. Applicants respectfully request that the rejections of this claim be withdrawn.

Claims 4 and 7 are dependent upon and add further limitations to independent claim 3 and are allowable for at least the same reasons discussed above in connection with claim 3. Applicants respectfully request that the rejections of these claims be withdrawn.

**Conclusion:**

In view of the above amendments and remarks, reconsideration of the rejections and allowance of claims 1, 3, 4 and 7 are respectfully requested.

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